Claims

[c1] 1. A method for predicting the color of a color standard exposed to weathering conditions, comprising:
determining the concentration of the colorants of the color standard;
obtaining weathered optical parameters for the color standard; and
predicting the color of the color standard from the concentration and weathered optical parameters.

[c2] 2. The method according to claim 1, wherein the weathered optical parameters comprise adsorption and scattering coefficients.

[c3] 3. The method according to claim 1, wherein the predicting comprises using a light scatter model.

[c4] 4. The method according to claim 3, wherein the light scatter model incorporates a Kulbelka-Munk theory.

[c5] 5. The method according to claim 3, wherein the light scatter model incorporates an Adding and Doubling theory.

[c6] 6. A method for predicting the shift in color of a color standard upon exposure to weathering conditions, comprising:
measuring the color of the color standard;
determining a color formula that matches the color standard;
obtaining weathered optical parameters corresponding to the colorants and concentration of colorants used in the color formula;
applying a light scatter model to the weathered optical parameters and colorant concentrations to determine the weathered color for color standard; and
predicting the shift in color of the color standard upon exposure to weathering conditions from the weathered color.

[c7] 7. The method according to claim 6, wherein the weathered optical parameters comprise adsorption and scattering coefficients.

[c8] 8. The method according to claim 6, wherein the predicting comprises comparing the weathered color to the color generated from the color formula.

[c9] 9. A method for determining a color formula that matches a color of a color standard and satisfies accelerated weathering test requirements, comprising:
receiving a sample of the color standard;
measuring the color of the color standard; and
determining a color formula that produces the measured color and satisfies accelerated weathering test requirements.

[c10] 10. The method according to claim 9, wherein the determining of a color formula comprises producing colorant characterization batches.

[c11] 11. The method according to claim 10, further comprising measuring the color of the colorant characterization batches.

[c12] 12. The method according to claim 11, further comprising applying a light scattering model to determine the optical parameters of the colorant characterization batches.

[c13] 13. The method according to claim 12, further comprising using the optical parameters and the measured color of the color standard with the light scattering model to determine a color formula that matches the color standard.

[c14] 14. The method according to claim 13, further comprising submitting the colorant characterization batches to an accelerated weathering test that exposes the batches to various weathering conditions.

[c15] 15. The method according to claim 14, further comprising measuring the color of the colorant characterization batches after undergoing the accelerated weathering test.

[c16] 16. The method according to claim 15, further comprising applying a light scattering model to the weathered colorant characterization batches to determine the weathered optical parameters of the batches.

[c17] 17. The method according to claim 16, further comprising predicting the color shift for the color formula due to weathering.

[c18] 18. The method according to claim 17, wherein the predicting of color shift

comprises obtaining weathered optical parameters corresponding to the colorants and concentration of colorants used in the color formula.

[c19] 19. The method according to claim 18, further comprising applying a light scatter model to the weathered optical parameters and colorant concentrations to determine the weathered color for the color formula.

[c20] 20. The method according to claim 19, further comprising comparing the weathered color to the color generated from the color formula.

[c21] 21. A method for predicting the shift in color of a color standard upon exposure to weathering conditions, comprising:
inputting a color measurement of the color standard;
determining a color formula that matches the color standard;
obtaining weathered optical parameters corresponding to the colorants and concentration of colorants used in the color formula;
applying a light scatter model to the weathered optical parameters and colorant concentrations to determine the weathered color for the color standard; and
predicting the shift in color of the color standard upon exposure to weathering conditions from the weathered color.

[c22] 22. The method according to claim 21, wherein the predicting comprises comparing the weathered color to the color generated from the color formula.

[c23] 23. The method according to claim 21, wherein the light scattering model incorporates at least one of a Kulbelka-Munk theory and Adding and Doubling theory.

[c24] 24. The method according to claim 21, wherein the optical parameters and weathered optical parameters comprise adsorption and scattering coefficients.

[c25] 25. A system for predicting the color of a standard exposed to weathering conditions, comprising:
means for measuring the color of the color standard;
means for determining a color formula that matches the color standard;
means for obtaining weathered optical parameters corresponding to the

colorants and concentration of colorants used in the color formula;
means for applying a light scatter model to the weathered optical parameters and colorant concentrations to determine the weathered color for color standard; and
means for predicting the shift in color of the color standard upon exposure to weathering conditions from the weathered color.

[c26] 26. The system according to claim 25, wherein the weathered optical parameters comprise adsorption and scattering coefficients.

[c27] 27. The system according to claim 25, wherein the light scatter model incorporates a Kulbelka-Munk theory.

[c28] 28. The system according to claim 25, wherein the light scatter model incorporates an Adding and Doubling theory.

[c29] 29. A system for determining a color formula that matches a color of a color standard and satisfies accelerated weathering test requirements, comprising:
a spectrophotometer that measures the color of the color standard;
a color database containing a plurality of colorants and optical parameters and weathered optical parameters associated with each of the colorants; and
a computing unit, coupled to the spectrophotometer and color database, that determines a color formula that produces the measured color and satisfies accelerated weathering test requirements.

[c30] 30. The system according to claim 29, wherein the computing unit uses a plurality of color formula keys to generate a color formula from the data stored in the color database that matches the color of the color standard and satisfies accelerated weathering test requirements.

[c31] 31. The system according to claim 30, wherein the computing unit predicts color shifts for the color formula due to weathering conditions.

[c32] 32. The system according to claim 31, wherein the computing unit predicts a color shift for the color formula by obtaining weathered optical parameters corresponding to the colorants and concentration of colorants used in the color

formula, applies a light scatter model to the weathered optical parameters and colorant concentrations to determine the weathered color for the color formula and compares the weathered color to the color generated from the color formula.

[c33] 33. A color formulation tool, comprising:
a data extraction component that extracts color data from a color database;
a color matching component that determines a color formula that matches the color of a color standard and satisfies accelerated weathering test requirements from the extracted color data; and
a color prediction component that predicts the shift in color for the color formula due to weathering.

[c34] 34. The tool according to claim 33, wherein the color matching component uses a plurality of color formula keys to generate the color formula.

[c35] 35. The tool according to claim 34, wherein the color prediction component predicts a color shift for the color formula by obtaining weathered optical parameters corresponding to colorants and concentration of colorants used in the color formula, applies a light scatter model to the weathered optical parameters and colorant concentrations to determine the weathered color for the color formula and compares the weathered color to the color generated from the color formula.

[c36] 36. A computer-readable medium storing computer instructions for instructing a computer system to predict the color of a color standard exposed to weathering conditions, the computer instructions comprising:
determining the concentration of the colorants of the color standard;
obtaining weathered optical parameters for the color standard; and
predicting the color of the color standard from the concentration and weathered optical parameters.

[c37] 37. The computer-readable medium according to claim 36, wherein the weathered optical parameters comprise adsorption and scattering coefficients.

[c38] 38. The computer-readable medium according to claim 36, wherein the

predicting comprises instructions for using a light scatter model.

[c39] 39. The computer-readable medium according to claim 38, wherein the light scatter model incorporates a Kulbelka-Munk theory.

[c40] 40. The computer-readable medium according to claim 38, wherein the light scatter model incorporates an Adding and Doubling theory.

[c41] 41. A computer-readable medium storing computer instructions for instructing a computer system to predict the shift in color of a color standard upon exposure to weathering conditions, the computer instructions comprising:
measuring the color of the color standard;
determining a color formula that matches the color standard;
obtaining weathered optical parameters corresponding to the colorants and concentration of colorants used in the color formula;
applying a light scatter model to the weathered optical parameters and colorant concentrations to determine the weathered color for color standard; and
predicting the shift in color of the color standard upon exposure to weathering conditions from the weathered color.

[c42] 42. The computer-readable medium according to claim 41, wherein the weathered optical parameters and optical parameters comprise adsorption and scattering coefficients.

[c43] 43. The computer-readable medium according to claim 41, wherein the predicting comprises instructions for comparing the weathered color to the color generated from the color formula.

[c44] 44. A computer-readable medium storing computer instructions for instructing a computer system to determine a color formula that matches a color of a color standard and satisfies accelerated weathering test requirements, the computer instructions comprising:
receiving a sample of the color standard;
measuring the color of the color standard; and
determining a color formula that produces the measured color and satisfies accelerated weathering test requirements.

[c45] 45. The computer-readable medium according to claim 44, wherein the determining of a color formula comprises instructions for producing colorant characterization batches.

[c46] 46. The computer-readable medium according to claim 45, further comprising instructions for measuring the color of the colorant characterization batches.

[c47] 47. The computer-readable medium according to claim 46, further comprising instructions for applying a light scattering model to determine the optical parameters of the colorant characterization batches.

[c48] 48. The computer-readable medium according to claim 47, further comprising instructions for using the optical parameters and the measured color of the color standard with the light scattering model to determine a color formula that matches the color standard.

[c49] 49. The computer-readable medium according to claim 48, further comprising instructions for submitting the colorant characterization batches to an accelerated weathering test that exposes the batches to various weathering conditions.

[c50] 50. The computer-readable medium according to claim 49, further comprising instructions for measuring the color of the colorant characterization batches after undergoing the accelerated weathering test.

[c51] 51. The computer-readable medium according to claim 50, further comprising instructions for applying a light scattering model to the weathered colorant characterization batches to determine the weathered optical parameters of the batches.

[c52] 52. The computer-readable medium according to claim 51, further comprising instructions for predicting the color shift for the color formula due to weathering.

[c53] 53. The computer-readable medium according to claim 52, wherein the predicting of color shift comprises instructions for obtaining weathered optical parameters corresponding to the colorants and concentration of colorants used

in the color formula.

[c54] 54. The computer-readable medium according to claim 53, further comprising instructions for applying a light scatter model to the weathered optical parameters and colorant concentrations to determine the weathered color for the color formula.

[c55] 55. The computer-readable medium according to claim 54, further comprising instructions for comparing the weathered color to the color generated from the color formula.

[c56] 56. A computer-readable medium storing computer instructions for instructing a computer system to predict the shift in color of a color standard upon exposure to weathering conditions, the computer instructions comprising:
inputting a color measurement of the color standard;
determining a color formula that matches the color standard;
obtaining weathered optical parameters corresponding to the colorants and concentration of colorants used in the color formula;
applying a light scatter model to the weathered optical parameters and colorant concentrations to determine the weathered color for the color standard; and
predicting the shift in color of the color standard upon exposure to weathering conditions from the weathered color.

[c57] 57. The computer-readable medium according to claim 56, wherein the predicting comprises instructions for comparing the weathered color to the color generated from the color formula.

[c58] 58. The computer-readable medium according to claim 56, wherein the light scattering model incorporates at least one of a Kulbelka-Munk theory and Adding and Doubling theory.

[c59] 59. The computer-readable medium according to claim 56, wherein the optical parameters and weathered optical parameters comprise adsorption and scattering coefficients.